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Abstract

Static and Dynamic Measurements on the Doppler Effect in an Experimental Fast Reactor

by

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On the basis of present knowledge, it appears that the Doppler coefficient will be the only reliable prompt negative feedback mechanism present in fast power reactors. Design of fast power reactors will, therefore, be dependent upon and strongly influenced by a detailed understanding of the behaviour of the Doppler effect under various conditions, in particular operating and accident conditions.

There are principally two different tools to determine the Doppler effect in fast reactors: a fast neutron critical facility and an experimental fast reactor. In the present paper the complementary potentialities of these two tools are outlined and an experimental programme for the detailed examination of the Doppler effect in an experimental fast reactor is discussed. Such a programme requires the use of an experimental fast

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reactor capable of safely undergoing both super-prompt critical and sub-prompt critical excursions. The Southwest Experimental Fast Oxide Reactor (SEFOR) has been designed specifically with this programme in mind. The requirements on the reactor and its design are briefly described. The various tests are discussed in detail. Special attention is given to the physical parameters involved in the evaluation of the Doppler effect and to the precision expected of the final results.

(1) Static Tests

In the static power tests, the fuel temperature is raised while keeping other temperatures relatively constant. The results will depend on the heat conductivity of the fuel.

(2) Oscillator Tests

Oscillator tests determine the transfer function of the reactor at various power levels. Both, the heat conductivity and the heat capacity influence strongly the results.

(3) Sub-Prompt Critical Step Tests

The results of these tests depend on the heat capacity and they are given in terms of delayed neutrons.

(4) Mild Super-Prompt Critical Ramp Excursions

Again the heat capacity of the fuel is of strong influence. The delayed neutrons are still of strong influence and the evaluation of the results has to take that into account.

(5) Strong Super-Prompt Critical Ramp Excursions

For the evaluation of the Doppler effect one only has to know the heat capacity of the fuel and the neutron life time of the reactor. It is expected to do these measurements with two SEFOR cores of different composition and it comes out that the various tests complement each other by providing data which have different dependence on the various properties of the fuel and the kinetics of the reactor.